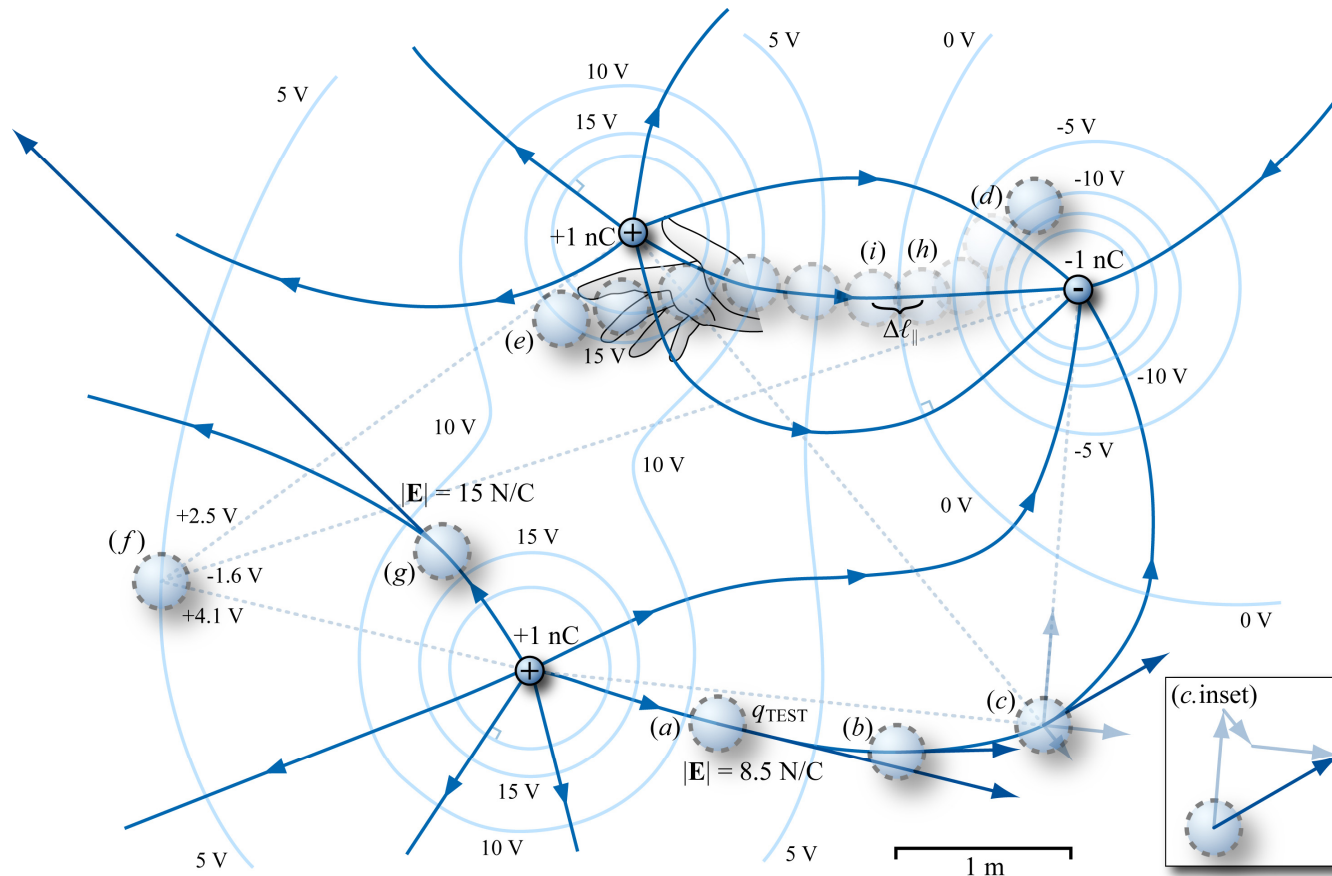


Electric fields and electric potentials

Charges create electric fields, and electric fields exert electric forces on charges.



Electric field

$$\vec{F}_E = q_{\text{TEST}} \vec{E} \quad [E] = \frac{N}{C}$$

$$|\vec{E}_{\text{FROM POINT}}| = \frac{1}{4\pi\epsilon_0} \frac{|q_{\text{POINT SRC}}|}{r^2}$$

$$\vec{E} = \sum_i \vec{E}_{\text{FROM POINT},i}$$

Electric potential

$$\Delta W_{\text{HAND}} = q_{\text{TEST}} \Delta V \quad [V] = \frac{J}{C}$$

$$\Delta U_E = q_{\text{TEST}} \Delta V \quad [V] = V$$

$$V_{\text{FROM POINT}} = \frac{1}{4\pi\epsilon_0} \frac{q_{\text{POINT SRC}}}{r}$$

$$V = \sum_i V_{\text{FROM POINT},i}$$

Relating \vec{E} and V

When shoving test charge anti/parallel to electric force,

$$|\Delta W_{\text{HAND}}| = |\vec{F}_{\text{AVG}}| \Delta \ell_{\parallel}$$

$$+q_{\text{TEST}} |\Delta V| = +q_{\text{TEST}} |\vec{E}_{\text{AVG}}| \Delta \ell_{\parallel}$$

$$|\vec{E}_{\text{AVG}}| = \frac{|\Delta V|}{\Delta \ell_{\parallel}}$$

(\vec{E} points “downhill”)

Electric field vector at a particular position \vec{r} points in the direction of the electric force that would be applied to a *positive* test charge. The magnitude of the electric field vector at \vec{r} is the strength of the electric force that would be exerted per each unit of test charge placed at \vec{r} .

Potential difference between points (a) and (b) – amount of work that would be required of your hand per each unit of charge pushed from (a) to (b). Positive work by hand is required to move a *positive* test charge from a location with lesser potential to a location with greater potential.